

[54] PULLING TOOL

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29/264, 265, 283, 282; 279/55, 58

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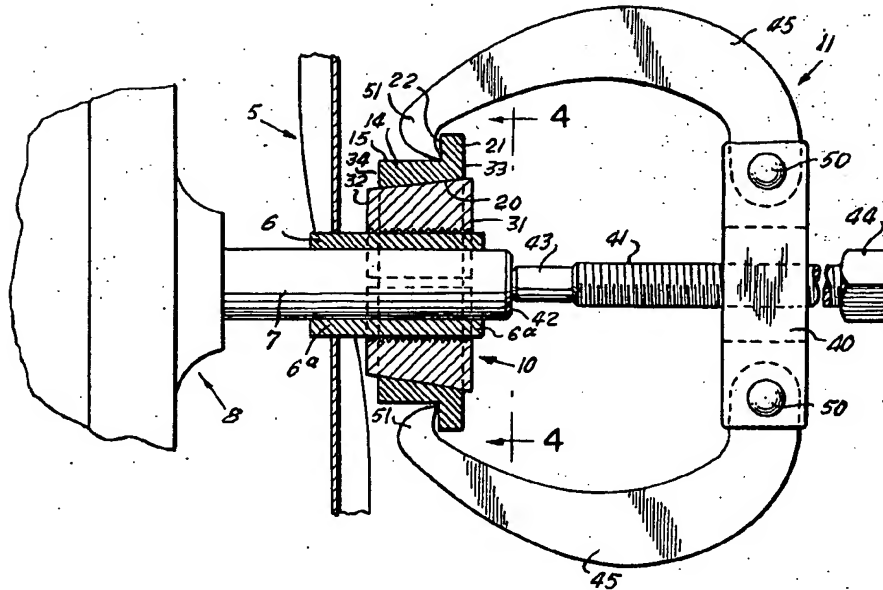
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[57] ABSTRACT

A pulling tool for removal of a hub from a shaft including a pulling ring having a peripheral flange engageable by a conventional puller and an internal tapered bore adapted to receive a pair of split semi-annular jaws which have internal teeth for engaging the outer surface of the hub on a shaft. The tool permits the engagement of a hub and the application of sufficient pulling force to pull the hub from a shaft on which the hub is engaged and stuck by corrosion and the like.

2 Claims, 4 Drawing Figures



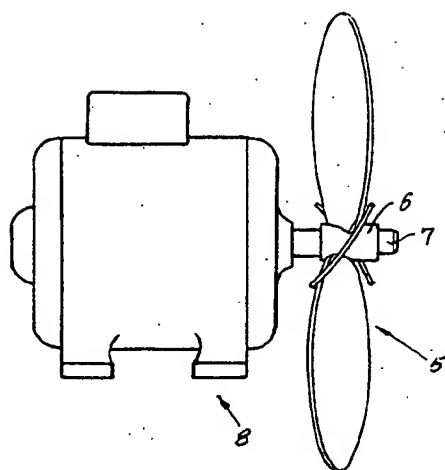


Fig. 1

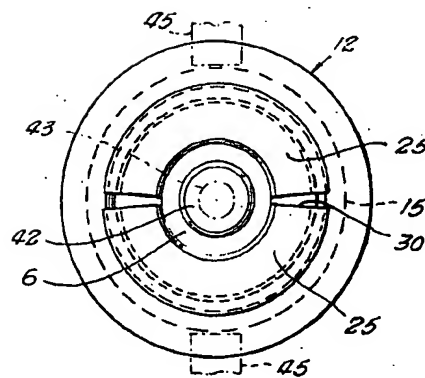


Fig. 4

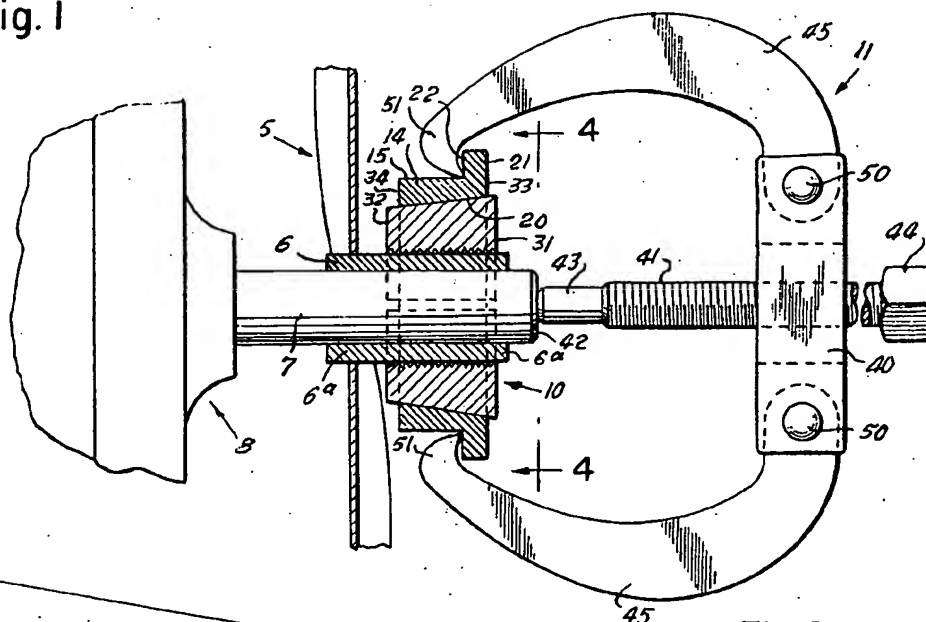


Fig. 2

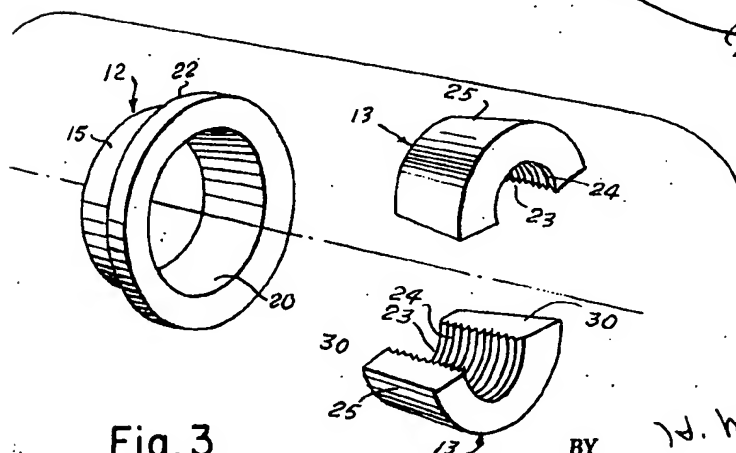


Fig. 3

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## PULLING TOOL

This invention relates to pulling tools and, more specifically, relates to a pulling tool for removal of a hub from a shaft.

The great expansion of the air conditioning industry, especially in its acceptance for residential cooling, has resulted in the use of a large number of outdoor fans for condenser cooling purposes. Such fans are exposed to weather the year round and thus are very susceptible to corrosion factors. Generally, the fans used for such purposes have cylindrical sleeve-like hubs provided with smooth external surfaces which are difficult to engage when attempting to remove the hub from a shaft on which it is mounted. More often than not, the end results of efforts at fan removal is fan destruction, which not only substantially increases the labor costs for personnel performing the services but also necessitates substantial increase in replacement parts costs. Accordingly, it is a principal object of the invention to provide a new and improved pulling tool for engagement of a hub, especially a fan hub, on a shaft and removal of the hub from the shaft.

It is another object of the invention to provide a pulling tool which has a minimum of operating parts.

It is another object of the invention to provide a pulling tool wherein dimensional tolerances are not especially critical.

It is another object of the invention to provide a pulling tool which is readily operable with available pullers capable of engaging the shaft and pulling tool of the invention for forcing the hub from the shaft.

It is a still further object of the invention to provide a fan puller which removes a hub from a shaft with minimum damage to both the shaft and the hub.

It is still a further object of the invention to provide a pulling tool of the character described which is useful with various diameter hubs by changing only the pulling jaws of the tool.

A still further object of the invention is to provide a pulling tool which is readily disassembled from the pulled hub after the hub has been disengaged from a shaft.

These and further objects and advantages of the invention will be apparent from reading the following description of a pulling tool embodying the invention in conjunction with the accompanying drawings wherein:

FIG. 1 is a side view in elevation of a typical fan having a sleeve-like mounting hub on the shaft of an electric motor;

FIG. 2 is an enlarged fragmentary view in section and elevation illustrating a pulling tool embodying the invention assembled on a fan hub and engaged by a suitable pulling tool;

FIG. 3 is an exploded perspective view of a complete pulling tool embodying the invention; and

FIG. 4 is a front view in elevation showing the pulling tool assembled on a hub mounted on a shaft as seen along the line 4-4 of FIG. 2.

In accordance with the invention there is provided a pulling tool for removing a shaft-mounted hub including an annular pulling ring having a peripheral pulling flange provided with a tapered bore, and a pair of circular segment pulling jaws having external tapered surfaces for seating against the tapered bore surface of the pulling ring and internal teeth adapted to engage the smooth surface of a fan hub.

Referring to FIG. 1 of the drawings, a typical fan 5 having a sleeve-like hub 6 is mounted on a shaft 7 of a motor 8. It will be obvious that the smooth outer surface of the sleeve-like hub 6 is difficult to engage with presently available tools and apply force without damage to move the sleeve hub relative to the shaft 7. A pulling tool embodying the invention is readily engageable, as shown in FIG. 2, with the hub of the fan for purposes of forcing the hub from the shaft.

Referring to FIG. 2, a pulling tool 10 embodying the invention is shown assembled on the fan hub 6 for removing the hub from the shaft 7. For applying a pulling force to the fan puller relative to the shaft, a suitable conventional puller 11 is illustrated engaged in a pulling relationship between the shaft and pulling tool 10.

The pulling tool 10 includes a pulling ring 12 and a pair of identical jaw segments 13. The pulling ring has a body portion 14 which has a cylindrical outer surface 15 and a tapered or conical internal surface 20. The pulling ring also includes a pulling flange 21 which preferably is formed integral with the body portion 14 and has a back pulling shoulder surface 22 which lies in a plane substantially perpendicular to the cylindrical outer side surface 15 of the pulling ring body. As obvious from FIG. 3, the pulling flange is a peripheral feature extending entirely around the pulling ring so that it is engageable at any location around the ring. The flange must be of sufficient thickness to withstand substantial pulling forces applied to it in removing a hub from a shaft. If desired, the shoulder surface 22 might be somewhat undercut or formed to slope radially inwardly toward the flange to lie at an acute angle with the surface 15 to facilitate engagement of the pulling ring surface by a puller, such as the tool 11.

Each of the jaw segments 13 has an internal longitudinally extending semi-cylindrical recess 23 defined by a tooth or ribbed surface 24 which is a segment of a cylindrical surface with teeth formed therein running transverse to the longitudinal axis of the surface to facilitate engagement with the cylindrical surface on the fan hub 6. The surface 24 may be formed of thread segments provided in the jaw segment by making the two jaw segments shown from a piece of cylindrical bar stock which is bored and threaded along its longitudinal axis to provide the tooth surface 24. The outer surface of the jaw segments is a tapered or conical surface 25 generated along the same longitudinal axis as the internal tooth surface 24. The degree of slope of the surface 25 corresponds with the slope of the pulling ring internal surface 20 so that when assembled on the fan hub 6, the segments 13 will firmly seat on and engage with the pulling ring surface 20. Circumferentially each of the pulling jaws 13 extends slightly less than 180 degrees, as is evident in FIG. 4, so that even when substantial pressure is applied to the jaws, forcing them inwardly around the fan hub, there will be no contact by the inside faces 30 of the two segments which would tend to hold them apart to lessen their gripping capability against the hub.

As particularly evident in FIG. 2, the length of the jaw segments 13 as measured along the longitudinal axis of the segments between the front faces 31 and the back faces 32 is greater than the length of the pulling ring 12 as measured along its longitudinal axis between its front face 33 and back face 34 to facilitate disassembly of the fan puller from the fan hub, as explained in greater detail hereinafter.

The puller 11 is a suitable conventional tool having a body 40 through which a threaded push rod 41 is rotatably supported for applying a force between the body and the end face 42 of the shaft 7. The push rod has a pushing foot 43 and a multi-faceted head end 44 engageable by a suitable tool, such as a wrench. A pair of C-shaped pulling arms 45 are pivotally supported by pins 50 from the opposite ends of the body 40. The pulling arms have hooked end portions 51 which are engageable with the back shoulder 22 of the pulling flange 21 on the pulling ring 12.

When a fan hub, such as the hub 6, requires removal from a shaft 7, the pulling ring 12 alone is placed over the shaft 7 and forward end portion 6a of the fan hub 6, with the back face 34 of the pulling ring facing the blades of the fan. The pulling ring is held manually at a position at which the longitudinal axis of the ring is substantially aligned with the axis of the shaft and fan hub, and thus the ring is concentric with and spaced from the fan hub 6. The pulling ring may be held at a position at which the back face 34 of the ring approximately touches the front or forward edges of the fan blades so that as much as possible of the free end of the shaft 7 extends through the pulling ring. The two jaw segments 13 are then placed on opposite sides of the fan hub 6, as shown in FIG. 4, with the inner toothed surfaces 24 of the jaw segments resting on the outer cylindrical surface of the fan hub. The jaw segments are moved rearwardly away from the free end of the fan shaft into the conical bore of the pulling ring until the back faces 32 of the jaw segments touch or are closely spaced from the front edges of the fan blades. The pulling ring is then moved forwardly away from the fan blades toward the front free end of the shaft 7 until the inner tapered surfaces 20 of the jaw segments. With the pulling ring being held with a light, even force forwardly so that the jaw segments 13 are supported firmly inwardly around the fan hub 6, the puller 11 is assembled on the pulling tool 10 and shaft. The push rod 41 is retracted sufficiently to permit the arms 45 to be swung into place, as shown in FIG. 2, with their hooked end portions 51 engaging the back face 22 of the peripheral pulling flange 21 on the pulling ring. With the arms held in this position, the push rod is then rotated in the body 40 by grasping the head end 44 of the rod and turning the rod until the foot 43 of the rod engages the free end face 42 of the fan shaft 7. During assembly of the pulling tool 10 on the fan hub and of the puller 11 on the pulling tool, a reasonable degree of care is exercised to properly align the jaw segments and pulling ring on the fan hub and to align the puller 11 with the shaft and pulling ring. It will be recognized that the results of such care will more firmly seat the jaw segments on the fan hub and the pulling ring with the jaw segments to optimize the application of the required forces with minimum damage to the various parts of the system.

The push rod 41 is then rotated by means of a suitable tool engaged with the foot 44 applying a force toward the free end face 42 of the shaft 7 while simultaneously applying a force away from the fan blades in the opposite direction. The opposite direction force is applied to the back face 22 of the pulling flange 21 on the pulling ring by the arms 45. The wedging effect of the engagement of the pulling ring tapered surface 20 against the jaw segment tapered surfaces 25 applies a radially inwardly directed force component to the jaw

segments which tightly squeezes them around the fan hub 6 against its outer cylindrical surface, while simultaneously the longitudinal component of the wedging force applied to the jaw segments parallel to the axis of the shaft and fan hub tends to force the fan hub 6 toward the free end 42 of the shaft 7. Careful, steady application of the pushing force of the push rod 41 pulls the fan hub 6 off the shaft 7 with essentially little or no damage to either the shaft or the surface of the fan hub 6 and with no danger of contact with the fan blades.

When so removing the fan from the shaft with the pulling tool, the force applied to the pulling ring may provide a sufficient wedging effect to the jaw segments that the fan puller may require a slight force or jaw to disengage it from the fan hub 6. The relative length of the jaw segment 13 and the pulling ring, as previously discussed, positions the back face 34 of the pulling ring a substantial distance in front of the fan blades, particularly by the time sufficient force is applied to and wedges the jaw segments 13 on the fan hub to remove the fan from the shaft. The space between the back face 34 of the pulling ring and the fan blades permits the pulling ring to be lightly tapped around its flange 21 toward the fan blades, without damage to the fan blades, to release the tapered surface 20 of the pulling ring from the surfaces 25 of the jaw segments. Reasonably short movement of the pulling ring toward the fan blades allows the jaw segments 13 to be disengaged from the surface of the hub 6 and lifted forwardly from the hub and from within the bore of the pulling ring. The pulling ring then is lifted from the fan hub. The substantial length of the toothed surface 24 which is engageable with the fan hub surface for pulling the hub off the shaft, permits the application of the force necessary to free the fan hub with minimum scarring or damage to the hub surface. The only actual contact with the shaft itself during the removal process is engagement of the foot 43 on the push rod on the puller 11 with the end face 42 of the shaft. Thus, there is no need to score the surface of the shaft 7, and the hub 6 should be reengageable on the shaft without the necessity for either the use of a new shaft or a new fan.

While only a single set of jaw segments 13 have been described and illustrated, it will be readily recognized that for any given pulling ring, several jaw segments may be used with the ring, each set having inner toothed surfaces 24 of different diameters while having the same dimensions on the outer tapered surfaces 25 so that the various sets of jaw segments permits a single pulling ring to be used with varying diameter fan hubs. It will be further recognized that the jaw segments 13 may be made in other than pairs, such as by using three instead of two segments, though such an arrangement would be appreciably more difficult to handle manually and is not considered to offer any substantial advantage over the arrangement shown and described.

It will be seen that the fan puller embodying the invention requires only a minimum number of parts, is operable with essentially no damage to the shaft or fan hub, is providable in assorted sizes to fit various diameter shafts with a minimum number of parts required to provide such flexibility, and is readily usable with standard pulling tools.

What is claimed and desired to be secured by Letters Patent is:

1. A pulling tool for removing a sleeve-type hub from a shaft comprising: a pulling ring adapted to be sup-

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ported concentrically over said hub in spaced relation thereto to define an opening within said ring around said hub, said ring having tapered internal seat surface means and an external peripheral pulling flange for engagement of said ring by a puller arm for applying a force to said pulling flange substantially parallel with the longitudinal axis of said hub; and a plurality of jaw segments, each of said jaw segments being a curved member having a generally cylindrical internal gripping surface adapted to engage said hub for pulling said hub from said shaft, said jaw segments each having a tapered external surface adapted to seat with said internal surface means of said pulling ring whereby each of said jaw segments is wedged between said pulling ring and said hub responsive to a force applied to the back face of said flange on said pulling ring, said jaw segments when assembled in said pulling ring occupying

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less than 360° of the space between said hub and said pulling ring, and each of said jaw segments being longer along a longitudinal axis than the length of said pulling ring along a corresponding longitudinal axis whereby portions of said jaw segments project from the space around said hub within said pulling ring at the back side thereof when said pulling ring is in a pulling relation against said jaw segments on a hub to be removed by said apparatus.

2. Apparatus in accordance with claim 1 wherein two of said jaw segments are provided, each of said segments extending circumferentially less than 180° within the space within said pulling ring around said hub when said segments are disposed within said ring on said hub in a pulling relation thereto.

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